FINAL

TOTAL MAXIMUM DAILY LOADS (TMDLS) FOR COPPER, MERCURY, NICKEL AND LEAD IN NY-NJ HARBOR

Prepared by U.S. Environmental Protection Agency, Region 2,
in cooperation with
the New York State Department of Environmental Conservation and
the New Jersey Department of Environmental Protection,
under the
New York-New Jersey Harbor Estuary Program.

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I. BACKGROUND INFORMATION

In June 1990, the U.S. Environmental Protection Agency (EPA) approved the listing of New York-New Jersey Harbor, by the States of New York and New Jersey, under Section 304(l)(1)(B) ("the short list") of the Clean Water Act. As a result of this listing, the States of New York and New Jersey and EPA agreed to cooperatively develop the Individual Control Strategies (ICSs) for dischargers of copper and mercury to the Harbor waters. Effluent limits included in ICSs must be consistent with waste load allocations (WLAs) and Total Maximum Daily Loads (TMDLs) established for the waterbody. In order to develop a unified TMDL approach for these interstate waters, a TMDL Workgroup was formed under the auspices of the New York-New Jersey Harbor Estuary (HEP) Program. The Workgroup consisted of the States of New York and New Jersey, citizens representatives, municipal dischargers, and other members of the various HEP workgroups. The tasks of the Workgroup were to: review currently enforceable water quality standards, choose an applicable set of numeric standards to be applied Harbor-wide, develop a uniform TMDL/WLA approach, and implement water quality-based effluent limits, where necessary, in a uniform manner.

In addition to the original 304(l) listed metals of mercury and copper, the Workgroup, after review of all available Harbor specific metals data, identified six additional metals of concern: arsenic, silver, lead, cadmium, nickel and zinc. In 1991 and 1992 ambient and source data were collected and analyzed using trace metal clean techniques. Sampling stations were located throughout the Harbor complex and included both New York and New Jersey tributaries. The results of these surveys indicated significantly lower metal concentrations as compared to historical data. The differences were attributed, in large part, to sample contamination and differing laboratory procedures used in collecting the historical data. For additional information regarding data collected during the Harbor monitoring surveys, refer to references 1-5. The monitoring studies for the Harbor were funded by EPA and the New York City Department of Environmental Protection.

Data collected during these surveys indicated that of the eight metals identified by the Workgroup, only four metals exceeded or potentially exceeded ambient water quality criteria: copper, mercury, nickel and lead. Since these four metals are water quality-limiting, TMDLs are required.

II. WATER QUALITY STANDARDS

Criteria to be used as the basis for TMDL development were based on recommendations from the NY-NJ Harbor TMDL/WQS workgroup. The Workgroup reviewed numeric water quality standards of the States of New York and New Jersey, as well as the federal criteria included in EPA's Toxics Criteria Promulgation (dated 12/22/92) and chose the following chronic criteria to be implemented Harbor- wide. These represent the most stringent State criteria applicable to the Harbor. The copper criterion is based on the development of a site-specific criterion, as described later in this section.

Copper: 5.6 ug/L dissolved
Nickel: 7.1 ug/L total recoverable
Mercury: 0.025 ug/L total recoverable
Lead: 8.5 ug/L total recoverable

The duration and frequency to be applied to chronic criteria are based on EPA guidance and are expressed as a four-day average not to be exceeded more than once in a three year period. In this study, the duration and frequency are interpreted as the average over a tidal cycle not to be exceeded in a three year period (HydroQual, 1994).

At the time of consideration of which marine water quality criteria should be applied to the waters of the Harbor for the purposes of TMDL establishment, different State criteria for copper applied and the criterion applicable to New Jersey waters was 2.9 ug/L total recoverable copper through the federal toxics criteria promulgation. The acute and chronic criteria values for copper were equivalent for both States. This was due to the assumption from the national copper criteria document (EPA 1984) that an acute criterion based on the endpoint of an embryo-larval mollusc test provides protection for chronic effects.

There was controversy on a national scale as to which form of the metal should be used in criteria implementation. This controversy was very significant in regard to the Harbor. Water quality data indicated frequent and widespread exceedance of the value expressed as total recoverable, but few exceedances of the value expressed as dissolved.

EPA and the States of New York and New Jersey agreed to develop a site-specific copper criterion for the Harbor to address the issues of potentially different State standards and the form of the metal to be regulated. The full report for this study is referenced (USEPA, April 1994). The site-specific study was administered by EPA through the auspices of the HEP using the Indicator Species Procedure. This procedure produces a biologically-based adjustment to the applicable New Jersey criterion of 2.9 ug/L total recoverable copper. The adjustment reflects physical and chemical differences affecting copper toxicity between Harbor water and the test waters used to establish the national criterion. The effect of these physical/chemical differences are determined by simultaneously conducted toxicity tests run on Harbor water and laboratory water used in national criteria derivation. The result is expressed as a Water Effect Ratio (WER), a ratio of the toxicity of copper in Harbor water vs. the laboratory water. The site-specific criterion is derived by multiplying the applicable criterion by the WER.

Based on the fact that EPA guidance (Prothro, 1993) was revised during the course of this study to recommend that metals criteria be expressed as dissolved, the States of New York and New Jersey agreed to express the site-specific NY/NJ Harbor copper criterion as dissolved. Based on the dissolved form of copper, the WER derived through the study for copper in the Harbor is 1.5.

Independent from the development of the site-specific copper criterion, a literature search and toxicity data obtained through this study on species critical to the development of the national marine copper criterion resulted in a recalculation of the national acute criterion value, from 2.9 ug/L total recoverable copper to 5.29 ug/L dissolved copper. In addition, EPA and the States of New York and New Jersey concluded that the 1984 copper criteria document assumption that the acute and chronic criteria are equivalent is no longer valid. Use of available data to calculate an acute to chronic ratio results in a recalculated national chronic criterion value of 3.75 ug/L dissolved copper. The recalculation of both the acute and chronic national marine copper criteria are further explained in the site-specific copper study report (EPA, 1994).

The site-specific acute and chronic copper criteria were calculated by multiplying the recalculated national criteria values by the WER of 1.5 as follows:

Site-specific acute copper criteria = 5.29 ug/L X 1.5 = 7.9 ug/L dissolved copper

Site-specific chronic copper criteria = 3.75 ug/L X 1.5 = 5.6 ug/L dissolved copper

III. DEVELOPMENT OF TMDLs

A. Introduction

TMDLs are required under Section 303(d) of the Clean Water Act. Section 303(d) requires States to develop TMDLs for waterbodies that cannot meet water quality standards after the implementation of technology-based effluent limitations. Once a TMDL has been established, Waste

Load Allocations (WLAs) and Load Allocations (LAs) can be allocated to point and nonpoint sources, respectively. Regulations concerning TMDLs are contained in EPA's Water Quality Planning and Management Regulations (40 CFR 130). EPA's April 1991 "Guidance for Water Quality-based Decisions: The TMDL Process" contains guidance on the programmatic elements of Section 303(d) and the Water Quality Management Regulation. The document provides guidance on developing Phased TMDLs for situations where nonpoint source controls need to be implemented. Specifically, the guidance states:

> "The TMDL, under the phased approach, includes (1) WLAs that confirm existing limits or would lead to new limits for point sources and (2) LAs that confirm existing controls or include implementing new controls for nonpoint sources. This TMDL requires additional data to be collected to determine if the load reductions required by the TMDL lead to attainment of water quality standards. Data collection may also be required to more accurately determine assimilative capacities and pollution allocations."

A phased TMDL also requires a schedule for the implementation and evaluation of point source controls, data collection, assessment of water quality standards attainment and additional modelling.

The TMDLs presented in this document utilize the phased approach. A phased approach is being proposed because in certain areas of NY-NJ Harbor, estimates for some loading categories (e.g. combined sewer overflows and storm water) are uncertain and further data collection is required for adequate model calibration. Also, ongoing programs are leading to load reductions from certain sources (e.g., pretreatment programs, combined sewer overflow, hazardous waste site remediation).

B. Analysis of Ambient Data

1. Harbor Survey Data

An enhanced database was necessary to enable development of TMDLs for metals in an area as complex as NY/NJ Harbor estuary. Extensive measurements of ambient concentrations of metals throughout the Harbor were necessary. All loadings of metals, including municipal treatment plants, storm water, combined sewer overflows, and boundary conditions needed to be quantified. The influence of hydrodynamic and hydrological factors such as stream flow and local tidal cycle variability needed to be addressed (i.e., spatial and temporal variability).

In addition to designing a monitoring scheme to address the above issues, the analysis of historical data on metals concentrations in the Harbor raised two additional issues within the TMDL workgroup which were intended to be addressed through the acquisition of appropriate data: 1) the validity of historical data (all metals data not obtained using "clean techniques" are known to yield artificially high results due to sample contamination and salt water matrix interference), and 2) the question of which phase of a metal should be measured and which phase would be most appropriate for water quality standards implementation. In order to achieve all of these goals, the monitoring surveys outlined below were conducted (the full report for each survey is referenced; Battelle Ocean Sciences was contracted to perform sample collection and analyses, in part because Battelle laboratories were equipped to perform "clean technique" metals analyses). These surveys and the resultant data are discussed further in the context of TMDL development in the modelling report of HydroQual Inc. (EPA's contractor), "Development of Total Maximum Daily Loads and Waste Load Allocations (TMDLs/WLAs) Procedure for Toxic Metals in NY-NJ Harbor: Modeling Report" (February 1994, Draft).

<u>January 1991 Ambient Survey and Municipal Monitoring</u> (Battelle, October 1991)

- 37 ambient sites throughout the Harbor were sampled. All samples were analyzed for the trace metals silver, arsenic, cadmium, copper, mercury, nickel, lead, and zinc. Metal concentrations were determined in four phases - total recoverable, acid-soluble, dissolved, and particulate. Other parameters measured were total suspended solids (TSS), particulate carbon (PC), and dissolved organic carbon (DOC).

- 21 municipal treatment plants throughout the Harbor were sampled for the same trace metals and phases as the ambient samples.

- This survey was conducted under heavier than average precipitation and high flow conditions.

- Results indicated that total recoverable measurements are equivalent to acid-soluble measurements, and therefore no distinction between these two types of measurements is necessary.

- The applicable criteria, as shown on page 3, were exceeded only by mercury and lead. Total recoverable mercury levels exceeded criteria throughout the Kills and at single locations in the Hudson, Hackensack, and Passaic Rivers and Newark Bay. Total recoverable lead levels exceeded criteria at one point in the Arthur Kill.

- Data from this survey showed a peak in TSS and total recoverable metals near the junction of the Hudson and Harlem rivers. To address this issue, a synoptic survey of water column turbidity was conducted, as well as another survey which included metals sampling over the tidal cycle as opposed to one-time grab samples. These surveys are discussed below.

<u>February 1991 Source Monitoring via Permit Modification (NYSDEC)</u>

- In February 1991, NYSDEC issued 22 permit modifications (Individual Control Strategies) requiring monthly effluent monitoring for a period of 1 year for eight heavy metals. Analyses were conducted for the total recoverable, dissolved, particulate, and acid soluble forms of the eight metals.

<u>April 1991 Synoptic Water Column Turbidity Survey (Battelle, August 1991)</u>

- Provided detailed information on the behavior of suspended solids at four Harbor locations (2 in the Hudson River, 2 in the Arthur Kill).

- Using a transmissometer, vertical profiles were obtained at these sites for temperature, salinity, and beam attenuation (turbidity). Also surveyed were several small-scale longitudinal and lateral transects.

- To augment transmissometer readings of beam attenuation, a limited number of discrete TSS measurements were taken.

- Data obtained during this survey indicated that short-term tidal cycle effects can create local elevations of solids levels in certain areas of the Harbor, due to sediment resuspension in some cases. The impact of this on metals levels was not totally understood, again suggesting the need for metals sampling over the tidal cycle (discussed below).

<u>May 1991 Intensive Ambient Master Station and Tributary Survey</u> (Battelle, January 1992)

- This survey was conducted to better assess the impact of what was learned about solids dynamics over the tidal cycle as a result of the Synoptic Water Column Turbidity.

- The survey was limited in spatial coverage (six stations), but each station was sampled at two water column depths four times over a tidal cycle for the following parameters:

    - The trace metals silver, arsenic, cadmium, copper, mercury, nickel, lead, and zinc. Each metal was measured in two forms - total recoverable and dissolved. The particulate phase of mercury was also analyzed.

    - TSS, PC, DOC and salinity.

- In June 1991, tributary sampling was conducted in the Passaic, Hackensack, Raritan, and Hudson Rivers. These tributaries were sampled twice (once on two different days) for the same trace metals and phases as the ambient and municipal samples in this survey, as well as for TSS, PC, and DOC. Except for the Hudson River, these tributaries were again sampled twice more for the same parameters, once in August 1991, and once in October 1991.

- The results indicated that except for the Hudson River, neither total recoverable or dissolved metal exhibits variability over depth or time. It was also shown that total recoverable metal levels closely follow TSS levels, and that variation in total recoverable metal concentrations is due to sediment resuspension.

- Few exceedances of metals criteria were observed, with the exception of the Hudson River. The observed exceedances were: mercury, lead, nickel, and zinc at the Hudson River; and mercury at three additional stations (Upper Bay, Arthur Kill, and Newark Bay).

<u>October 1991 Low Flow Ambient Survey</u> (Battelle, May 1992)

- In October 1991, the following parameters were measured at eighteen ambient stations:

    - The trace metals silver, cadmium, copper, mercury, nickel, lead, and zinc (arsenic was not included). Each metal was measured in two forms - total recoverable and dissolved.

    - TSS, PC, DOC, and salinity.

    - Turbidity and hydrographic water-column data for each station through CTD-transmissometry information intregrated at 1 meter intervals.

- In November and December of 1991, the same 21 municipal treatment plants which were included in the January 1991 survey were sampled for the same trace metals and phases as the ambient samples in this survey; these municipal samples were also analyzed for TSS, PC, and DOC.

- In January and February of 1992, tributary sampling was conducted in the Passaic, Hackensack, Raritan, and Hudson Rivers. These tributaries were sampled for the same trace metals and phases as the ambient and municipal samples in this survey, as well as for TSS, PC, and DOC.

- Similar to the results of the January high flow survey, mercury exceedances were observed to occur throughout the Harbor.

February 1992 Sediment Survey (Battelle, June 1992)

- This survey was conducted to facilitate assessment of the impact of the sediment boundary on ambient levels of metals in the water column, and to validate historical metals data. The survey report contains information on the condition of Harbor sediment including sediment toxicity, sediment texture and chemistry, and porewater chemistry.

- Parameters measured for whole sediment:

    - Toxicity bioassay of *Ampelisca abdita*
    - Grain size, total organic carbon, redox potential
    - Acid volatile sulfides/simultaneously extracted metals (AVS/SEM): silver, arsenic, cadmium, copper, mercury, nickel, lead, and zinc
    - Total metals: Same metals as for AVS/SEM

- Parameters measured for porewater:

    - Salinity, pH, DOC, ammonia (as NH_4^+), dissolved sulfides)
    - Total metals: Same metals as for AVS/SEM

- Although the bioassays indicated that Harbor sediments are highly toxic to *Ampelisca*, the data also indicated that on the basis of the ratio of SEM:AVS, it is unlikely that any mortality observed can be attributed to metals toxicity. In general terms, when present in sufficient quantity, AVS binds to metals, rendering them non-toxic and non-bioavailable to biota. The only observations of a SEM:AVS ratio greater than one (indicating the potential for metals toxicity) ocurred at two stations (the Outer Harbor and Hackensack River) for the metals copper, lead, and zinc.

Combined Sewer Overflow and Wet Weather Municipal Influent Monitoring (Battelle, January 1993)

- This survey document reports physical and chemical measurement results of combined sewer overflow (CSO) discharge and wet weather influent (as CSO surrogates) from municipal treatment plants in New York and New Jersey.

- Six CSO and 23 influent samples were collected by the New York City Department of Environmental Protection during wet weather conditions. One CSO sample and one pumping station sample were collected by the New Jersey Department of Environmental Protection.

- The following parameters were measured: TSS, PC, DOC, and the following metals in the total recoverable phase: Silver, cadmium, copper, mercury, lead, nickel, and zinc.

2. Probability Distributions

In order to determine compliance with criteria, which are based on once in three years exceedances, target long-term average concentrations were determined. The long-term average concentrations were developed from ambient metals data collected during the Harbor surveys. It is hypothesized that the high flow, low flow and diurnal grab samples sufficiently simulate a full range (variability) of metals concentrations in the Harbor.

Chronic aquatic life criteria are expressed as four-day averages and correspond to a compliance frequency of 99.63% based on the once-in-three year exceedance. Log probability distributions of ambient concentrations were developed to assess compliance with the applicable criteria (see Figures 1-4). A full description of this approach can be found in HydroQual's report (February 1994, draft). In order to have sufficient data to establish probability distributions, the Harbor was divided into eight spatial regions: Hudson River from Bear Mountain to the Battery, Hudson River from the Battery to the Narrows (Inner Harbor), Hudson River from the Narrows extending out to the New York Bight (Outer Harbor), the Arthur Kill and Kill Van Kull (the Kills), East and Harlem Rivers, Raritan River and Raritan Bay, and the Hackensack and Passaic Rivers and Newark Bay. For each region, log probability distributions were developed from data collected during the January, May, and October surveys. For copper, a metal with a dissolved criterion, variability was not observed over the tidal cycle. Therefore, the dissolved ambient data were assessed directly against the long-term average concentration. For metals with chronic criteria expressed as total recoverable (nickel, lead and mercury) distributions were developed to approximate four-day or tidal averages. The probability distributions developed for the total recoverable criteria were approximated by taking the sum of the dissolved and particulate metal concentrations. The probability distributions project ambient exceedances for mercury in several of the Harbor regions, no exceedances of the copper criterion, and exceedances of the lead and nickel criteria in the Kills.

C. Model Development

HydroQual developed a toxic metals model using the Chemical Transport Analysis Program (CTAP). CTAP uses the principles of mass balance to obtain a steady-state solution to a series of linear differential equations accounting for:

advective dispersive transport;
solid phase vertical transport;
phase partitioning;
transport across the water column/sediment interface;
transport across the air/water interface; and
point and nonpoint source loading.

The CTAP model framework for the Harbor consists of the 490 water column segments as developed for the expanded NYCDEP 208 model, the New York Harbor Steady-State Model (NYSSM), and an additional 396 sediment segments. The water column is divided into 302 one layer segments and 188 two-layer segments. The geographic area covered by the model is from Bear Mountain to the Atlantic Ocean by the Ambrose Lighthouse. The model segmentation is shown in Figure 5.

The physical transport used in CTAP is based upon results obtained from the application of the three-dimensional hydrodynamic Estuarine and Coastal Ocean Circulation Model (ECOM-3D) to the Harbor. The resulting model, the New York Harbor Hydrodynamic Model, was developed for NYCDEP as part of a facilities planning effort for CSO abatement.

CTAP also allows for specification of solid phase transport, including: water column settling, settling from the water column to the bed, resuspension from the bed to the water column, and burial of bed solids. Solid phase vertical transport rates were determined through calibration to suspended solids data collected during the October and January calibration periods. The settling velocity was set at 1 ft/d. For both calibration periods, the data indicated that there was little significant net deposition of solid phase matter from the water column to the bed. On a mass basis, the amount of material leaving the water column and entering the bed is equal to the amount of material resuspended from the bed to the water column.

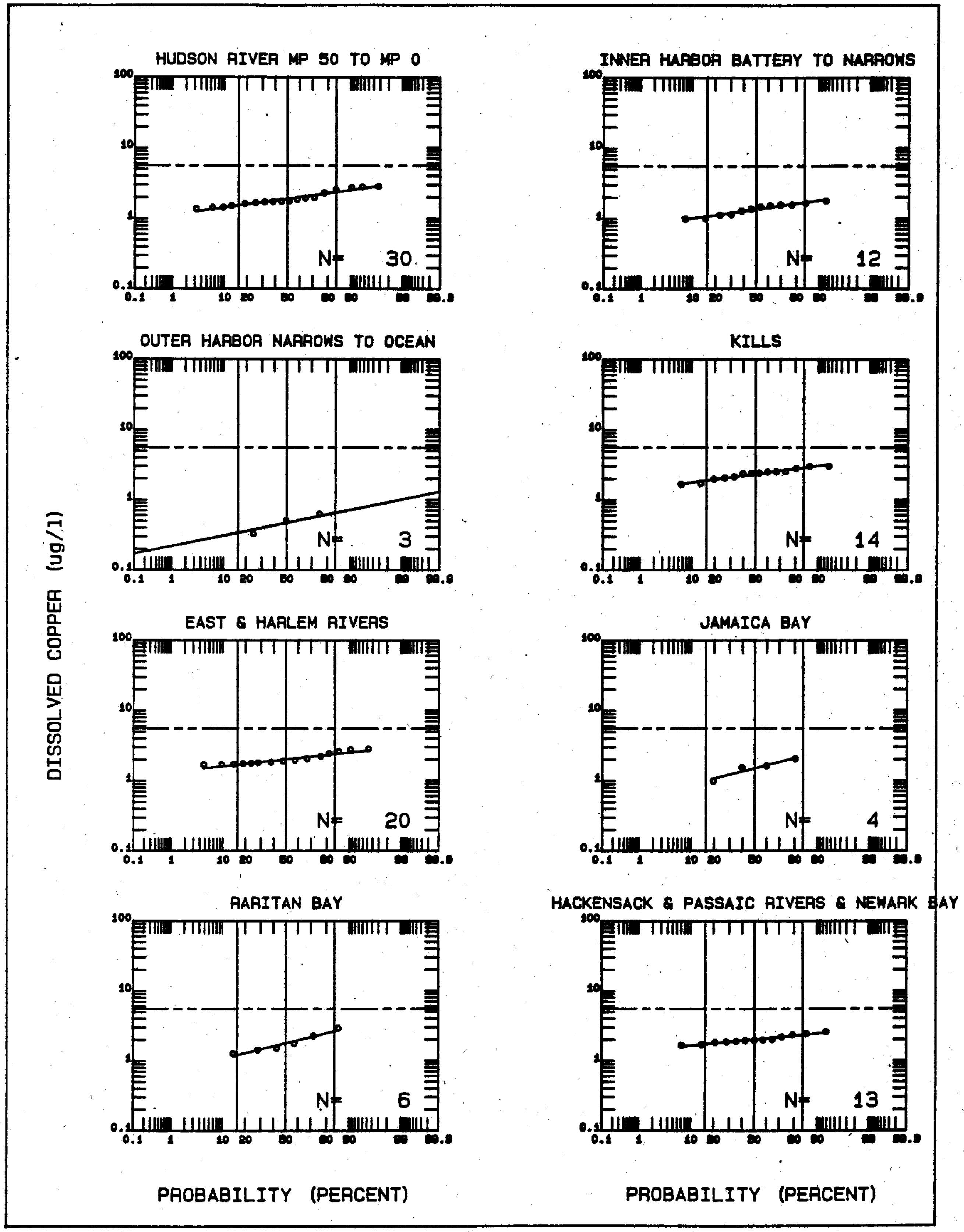


Figure 1. Regional Log Probability Distributions of Ambient Dissolved Copper (January, May, and October, 1991)

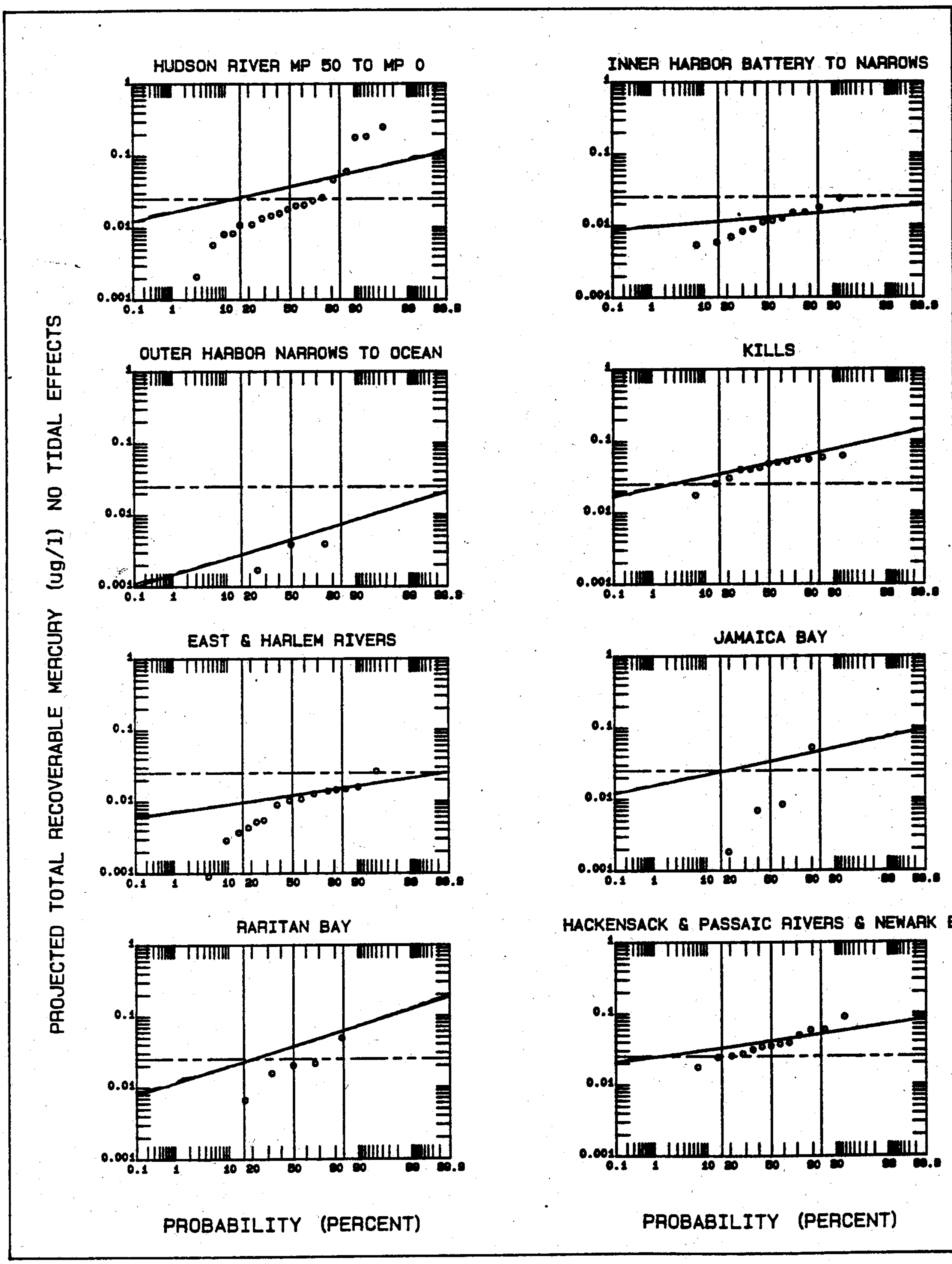


Figure 2. Log Probability Distributions of Total Recoverable Mercury for a Projected Non-Tidal Condition.

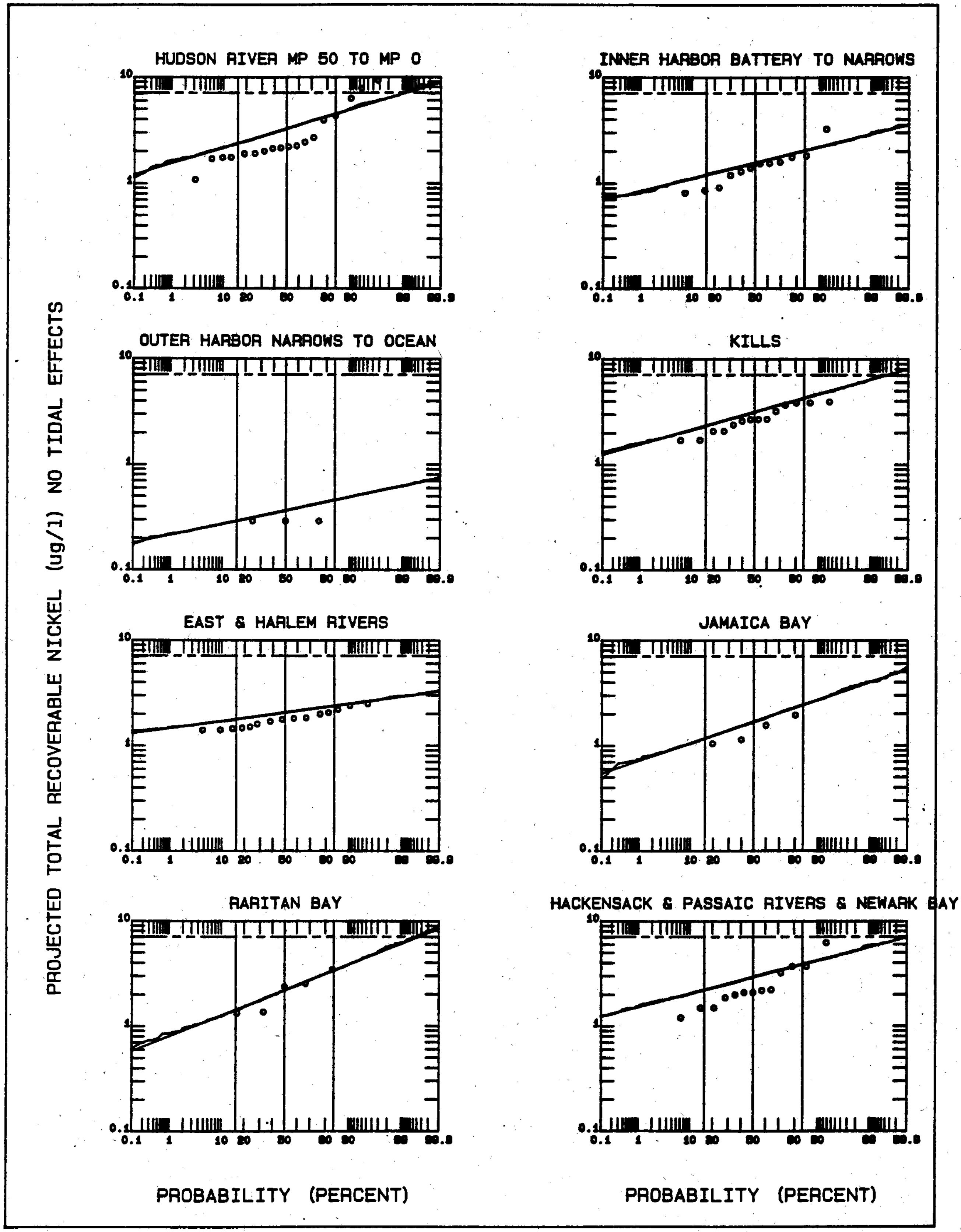


Figure 3. Log Probability Distributions of Total Recoverable Nickel for a Projected Non-Tidal Condition.

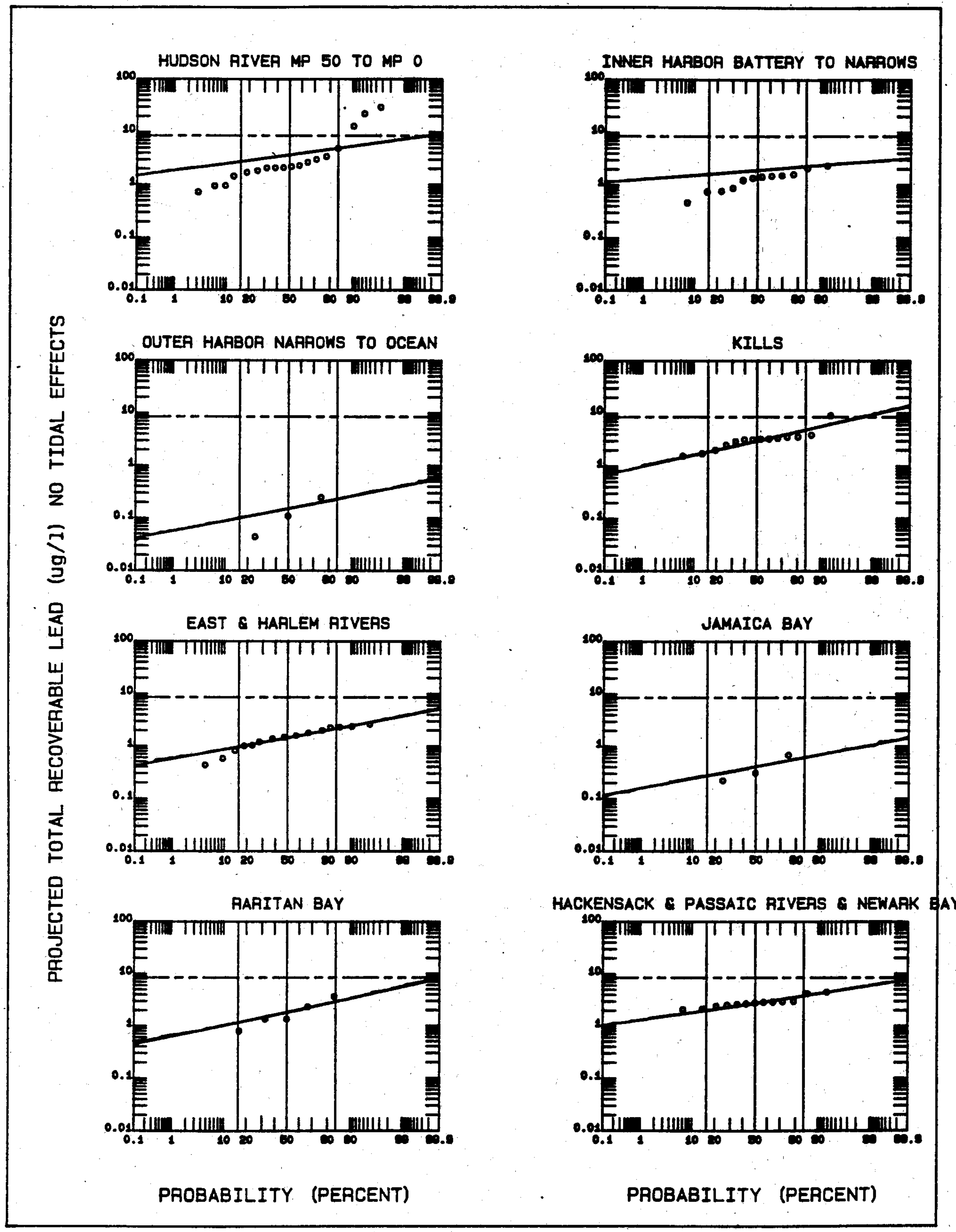
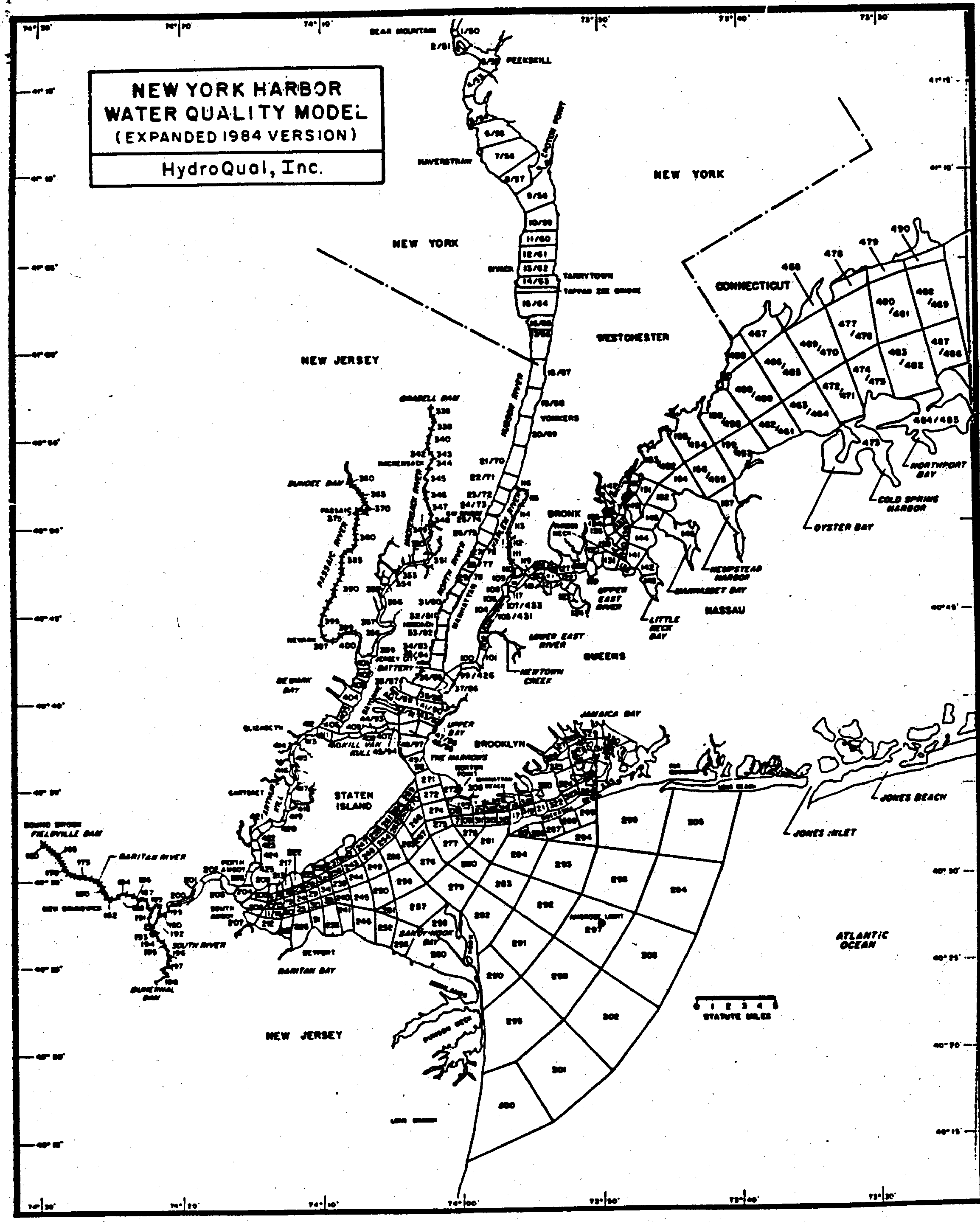


Figure 4. Log Probability Distributions of Total Recoverable Lead for a Projected Non-Tidal Condition.



EXPANDED 490 SEGMENT HARBOR MODEL

Figure 5

In CTAP, the rates of adsorption and desorption for the metals of concern were defined by a partition coefficient. The partition coefficient is the metal-specific ratio of the solid phase metal to the dissolved phase metal. For a more complete description of the Harbor modelling, refer to HydroQual's modelling report (February 1994, draft).

The model was calibrated for the original eight metals of concern. For mercury, however, calibration could not be achieved using the available loading data. Mercury calibration was achieved by the addition of a load of unidentified source with a magnitude of 7.0 lbs/day, which is 53% of the total mercury load. Initially, it was thought that this load may be attributed to a combination of in-place sediment and atmospheric loads. EPA strongly believes the 7.0 lbs/day should be attributed soley to atmospheric deposition and not to in-place sediment loads. The sediment data collected as part of the Harbor study indicates that sediment type and metal loadings varied greatly from region to region throughout the Harbor. Therefore, we would expect that the 7.0 lbs/day, if attributed to in-place sediment, would be distributed unevenly throughout the Harbor in "hot spots" of sediment loading. If this were the case, the model would predict that the 7.0 lbs/day are distributed among a few Harbor regions where sediment "hot spots" may be found. Therefore, the fact that the model only calibrates when the 7.0 lbs/day is distributed evenly through the Harbor strongly supports the assumption that the 7.0 lbs/day load be attributed entirely to atmospheric deposition.

The above explanation of the unknown mercury load is further supported by EPA's October 8, 1993 Report to Congress entitled "Deposition of Toxic Air Pollutants to the "Great Waters". EPA identified atmospheric deposition as a major source of mercury in water, fish and sediment of large lakes. The EPA report also referenced a study conducted in Sweden that indicated that a large portion of the atmospheric mercury deposited within the drainage basin finds its way into lakes via storm water runoff.

To facilitate the task of developing TMDLs for the four metals of concern, spreadsheets of load matrices which summarize calibrated model results were developed for use by EPA and the States of New York and New Jersey. The October calibration low flow transport field was chosen for projections. Loadings were adjusted to reflect design flows for municipal facilities and permitted flows for industrial facilities. The spreadsheets allow the user to specify loadings and predict the response in each of the Harbor segments. The total response is then compared to the criteria to determine compliance. The criteria in the spreadsheet are the long-term averages from the probability distributions which meet the applicable criteria at the chronic frequency of 99.63%. The spreadsheets were used to determine various loading scenarios which would result in compliance with the criteria. The loads which can be manipulated within the spreadsheets are as follows:

- Municipal & industrial loads to each of the 8 loading zones;
- CSO loads Harbor-wide;
- Storm water loads Harbor-wide; and
- Boundary load conditions for the Hudson, Hackensack, Passaic and Raritan Rivers.

D. Loadings Used in TMDL/WLA/LA Development

1. Municipal and Industrial Loads

The facilities included in the TMDL are based on those originally listed on New York and New Jersey Section 304(l)(1)(C) lists. A list of these facilities is included in Appendix 1. Also included in Appendix 1 is a listing of facilities used for assessing total metal loadings to the Harbor and a final list of facilities considered in WLA development.

Municipal and industrial treatment plants discharging to the eight Harbor regions were identified. The States of NY and NJ were asked to identify both municipal and industrial point source dischargers of the four metals of concern, the design flows of each facility, and the available metals data. The Workgroup agreed that only data collected using "clean techniques" would be used for loading data for the modeling effort. In cases where data were not available, the geometric mean of all the Battelle clean technique data, for that specific metal, would be assigned as a load. This was done for all industrial and some minor municipal facilities. Therefore, only clean technique data were used in modeling projections to assess compliance with standards. Data, other than Battelle clean technique data, were used to set WLAs based on existing loads (refer to Section E). All the available data for the facilities are included and explained in Appendix 2.

2. Runoff

Metal loadings to NY-NJ Harbor due to runoff were calculated through the implementation of the New York City 208 Rainfall Runoff Modeling Program (RRMP). RRMP is structured so that the drainage basin for NY-NJ Harbor is divided into 241 modeling areas. Modeling areas are defined by both sewer district and drainage area. For each of the modeling areas, a variety of land use types are considered. Runoff flows (CSO and storm water) estimated are as follows:

Table 1. Runoff Distribution

TYPE OF RUNOFF	HARBOR-WIDE	NY	NJ
CSO (cfs)	424	312	112
STORM WATER (cfs)	1005	360	645
TOTAL (cfs)	1429	672	757

Combined Sewer Overflows

As previously noted, six CSOs in NY and one in NJ were sampled and analyzed using clean techniques. The CSO sampling entailed three dates and five sewer districts. To supplement the CSO sampling effort, 23 wet-weather influents were sampled at 10 NYC STPs and 1 pumping station in NJ. Log mean concentrations of all the data were used Harbor-r-wide.

Storm Water

Data for storm water are based on the NYCDEP report "Headworks Analyses and Reevaluation of Sewer Use Limits" d the HydroQual Task 7.1 Report. Log mean runoff concentrations of the Headworks data for each metal were used to quantify storm water concentrations in NY. NJ storm water concentrations were determined primarily on the basis of the Task 7.1 report. Headworks data were used to supplement the NJ storm water characterization, when necessary. A summary of the metal concentrations for CSO and storm water which were applied Harbor-wide are summarized below. For lead, NJ storm water concentrations are based on the Task 7.1 Report which reflect more diverse land usage than data collected solely in New York City.

Table 2. Summary of metal concentrations for runoff (all concentrations in ug/L total recoverable metal).

Runoff	Cu	Hg	Ni	Pb
CSO	152.9	0.259	15	97.1
Storm Water	66.6	0.265	21.1	119.2 (NY)
				29 (NJ)

4. Boundary Loads

Boundary conditions for the Hackensack, Passaic, Raritan and Hudson Rivers are based on measured data collected during the October 1991 survey or log mean concentrations, as appropriate.

Table 3. Summary of boundary metal concentrations (all concentrations in ug/L total recoverable metal).

Tributary	Cu	Hg	Ni	Pb
Passaic	5.0	0.004	2.4[1]	2.6[1]
Raritan	4.2	0.004	1.6	0.6
Hackensack	6.2	0.002	0.7	0.9
Hudson	3.7	0.005	2.1	2.0

[1] Value is the log mean concentration from the probability distribution, excluding the highest value.

5. Atmospheric Deposition

No direct measurements were available for atmospheric deposition in NY-NJ Harbor. Data for the TMDLs were obtained from historical data reviewed by HydroQual (1991). The following deposition rates were used for the urban areas of NY-NJ Harbor:

Cu: 518 g/ha/yr
Ni: 286 g/ha/yr
Pb: 850 g/ha/yr

No data were available for mercury, thus the load attributed to atmospheric deposition was set at zero. Data available for lead were collected between 1967-1979. The lead deposition rate may be high since these data were collected during the phase-out of leaded gasoline.

E. RESULTS OF MODELING PROJECTIONS

The load matrices developed by HydroQual were used to predict exceedances of applicable ambient criteria under existing loading conditions. The loads used in the matrices have been described in the previous section. Exceedances are predicted for waterbodies denoted by an "X" in Table 4. These waterbodies are water quality-limited and therefore, require the development of a TMDL. Waterbodies without an "X" do not require TMDL development for the metals of concern.

Projections for mercury indicate Harbor-wide exceedances and system-wide TMDL development. As discussed previously in Section II.C., the mercury model could not be calibrated without the addition of an unidentified load of 7.0 lbs/day. This load is believed to be attributed to atmospheric deposition. Municipal and industrial dischargers are not a significant source of mercury to the Harbor. For nickel and copper, the model projects that major reductions in storm water and CSOs would be required in the Hackensack, Raritan and Passaic Rivers in order to meet standards. In addition, major reductions are projected for municipal and industrial discharges in these areas. Similarly, for lead, major reductions are projected in CSOs and storm water in the NJ tributaries. For lead, municipal and industrial discharges are not a significant contributor to the total load. Projected exceedances in the Kills are driven by loads from the NJ tributaries.

Table 4. Waterbodies needing TMDLs.

Waterbody	Copper	Mercury	Nickel	Lead
Hudson River		X		
Inner Harbor		X		
Outer Harbor		X		
Arthur Kill/Kill Van Kull	X	X	X	X
East R./Harlem R.		X		
Jamaica Bay		X		
Raritan River/Bay	X	X	X	X
Hackensack R./Passaic R./Newark Bay	X	X	X	X

F. TMDLs/WLAs/LAs

1. Copper, Nickel and Lead

As previously described in Section III.A., a phased TMDL approach is being proposed. The rationale for using this approach in New York-New Jersey Harbor is based on the limited ambient and loading data and the uncertainties in the model calibration for the NJ tributaries. For the NJ tributaries, the following statements can be made:

o <u>Data Deficiencies</u>

1. Ambient data: A limited data set of clean technique metals data is available.

2. Municipal/Industrial Data: Two effluent data (using clean techniques) points are available for each of the municipal facilities discharging to the NJ tributaries. No clean technique data are available for industrial facilities.

3. Combined Sewer Overflows (CSOs): Limited NJ CSO data are available (1 CSO and 1 wet-weather influent).

4. Storm Water: No actual NJ storm water data are available.

o Analysis of Ambient Data

1. Ambient data were analyzed using log probability distributions. Exceedances of criteria can be determined by projecting data to the appropriate duration and frequency equivalent to 99.63% for chronic criteria. Due to limited ambient data, data for the Hackensack R., Passaic R. and Newark Bay were grouped in order to provide a larger database for projections.

2. Examination of the log probability distributions (Figures 1-4) for the Hackensack/Passaic/Newark Bay and Raritan Bay regions indicates that the criteria are projected to be met at the appropriate duration and frequency.

o Model Calibration

1. Due to limited ambient and loading data, the state of model calibration is unknown in the Hackensack River, Passaic River, Newark Bay, and Raritan River.

2. Under existing loading conditions the model projects that large exceedances will occur in the NJ tributaries.

Based on the model projections, using best estimates of existing loads, the Hackensack R., Passaic R., Newark Bay and Raritan Bay are water quality-limited for copper, nickel and lead and require the development of TMDLs. However, since the limited ambient data indicate that criteria are not exceeded, existing loads are adequate to meet standards under Phase I of the TMDL. Table 5 contains the TMDLs/WLAs/LAs for waterbodies where TMDLs are needed. All the WLAs are based on existing loads, calculated using the average of data analyzed by the facility. The individual WLAs for each facility are contained in Appendix 1. The WLAs listed in Appendix 1 are not enforceable permit limits. The enforceable permit limits for municipal and industrial dischargers will be developed by the States based on the permittee's existing effluent quality.

The margin of safety which accounts for the uncertainty in the model is considered to be incorporated into the conservative assumptions used to develop the TMDLs.

Table 5. TMDLs/WLAs/LAs (lbs/day total recoverable metal) for Waterbodies.

TMDL: COPPER	LOADING ZONES		
WLA/LA	HACK/PAS/NEWARK	KILLS	RARITAN R/BAY
MUN./IND.	11.16	31.21	34.85
CSO	17.30	17.10	1.40
STORM WATER	53.30	35.10	42.70
BOUNDARY	2.73	0.00	3.90
ATMOSPHERIC	7.40	46.40	67.60
TMDL	**91.89**	**129.81**	**150.45**

Table 5. (cont'd) TMDLs/WLAs/LAs (lbs/day total recoverable metal) for Waterbodies.

TMDL: NICKEL	LOADING ZONES		
WLA/LA	HACK/PAS/NEWARK	KILLS	RARITAN R/BAY
MUN./IND.	18.84	20.06	19.93
CSO	1.70	1.68	0.14
STORM WATER	16.90	11.03	13.54
BOUNDARY	2.07	0.00	1.49
ATMOSPHERIC	4.08	25.61	37.32
TMDL	**43.59**	**58.48**	**72.42**

TMDL: LEAD	LOADING ZONES		
WLA/LA	HACK/PAS/NEWARK	KILLS	RARITAN R/BAY
MUN./IND.	29.17	31.88	7.51
CSO	10.99	10.86	0.89
STORM WATER	23.19	15.27	18.57
BOUNDARY	1.69	0.00	0.56
ATMOSPHERIC	12.14	76.10	112.14
TMDL	**77.18**	**134.10**	**139.67**

Phase I of the TMDL would require permits which include existing effluent quality-based limits, monitoring requirements (including ambient, effluent, CSO, and storm water monitoring) and studies to evaluate the effectiveness of pretreatment, corrosion control, pollution prevention and treatment optimization to reduce metal loadings. Permits will contain limits based on revised TMDLs/WLAs/LAs, as necessary. In accordance with available guidance on the establishment of water quality-based effluent limits, the States of New York and New Jersey, have developed or will develop, respectively, permit effluent limits that will ensure individual WLAs contained in Appendix 1 are met. The numerical value of the permit limits may be different than the aforementioned WLAs.

Phase II of TMDL/WLA/LA development will include a recalibrated model, based on the data collected, for the NJ tributaries. Once sufficient data have been collected and the water quality model has been adequately calibrated, Phase II TMDLs will be developed, adopted and implemented, as necessary, by the States of New York and New Jersey with assistance from EPA. However, if significant interstate issues arise and the Commissioners of the New York State Department of Environmental Conservation and the New Jersey Department of Environmental Protection jointly request an EPA promulgation, EPA will promulgate Phase II TMDLs for the interstate waters of New York-New Jersey Harbor.

2. Mercury

Many of the principles described under copper, nickel and lead TMDL development also apply to mercury. Ambient exceedances, however, are more prevalent throughout the Harbor as compared to the other three metals. In addition, there is an unidentified load of 7.0 lbs/day which was added to facilitate model calibration. This load drives exceedance of the mercury standard throughout the Harbor. As described in Section II.C., this load is believed to be attributed to atmospheric deposition. The TMDL for mercury was developed using estimates of reductions in atmospheric deposition due to implementation of the Clean Air Act.

It is estimated that aggressive national implementation of the Clean Air Act will result in reduction in atmospheric mercury loads of 85-90% nationally, including New York-New Jersey Harbor, within the next 10-15 years. For TMDL development a conservative estimate of a projected 85% reduction and a 30% margin of safety were used to estimate reductions in atmospheric deposition. Therefore, the TMDL calculations are based on a 60% [0.85 - (0.85 x 0.30) = 0.6] reduction in direct atmospheric loading of mercury to the waters of the Harbor over the next 10-15 years.

Studies have indicated that the major source of mercury to storm water is direct atmospheric deposition to land areas within the drainage basin. For the Harbor TMDL it was assumed that 30% of the storm water and 10% of the CSO and boundary loads will also be reduced by enforcement of the Clean Air Act over the next 10-15 years.

In calculating Phase I Mercury TMDLs for New York/New Jersey Harbor, we will assume Clean Air Act implementation based reductions of atmospheric loads of mercury over the next 10-15 years, as follows:

	Present Load lbs/day	Reduction %	Reduced Load lbs/day
Direct Atmospheric	7.0	60	2.8
Storm Water	5.438	30	3.807
CSO	0.626	10	0.564
Boundary	0.158	10	0.142

Under this scenario, the Phase I TMDLs for mercury will result in Municipal and Industrial dischargers be issued limits based on existing loads, direct atmospheric, CSO, storm water and boundary loads will be reduced by the above long-term Clean Air Act implementations based reductions.

Over the next few years, EPA, the States of New York and New Jersey, and the NY-NJ Harbor dischargers will be working with the U.S. Army Corps of Engineers towards the proposed development of long-term water quality and hydrodynamic modeling effort focused on organic pollutants such as PCBs, dioxin, PAHs and the metal mercury. In addition, dischargers will be required to collect additional loading and ambient data for mercury. The focus of the mercury-related effort will be to fully quantify and upgrade data on direct atmospheric, storm water, CSO, boundary, and municipal and industrial loads and to identify other potential sources, such as localized in-place sediment loads which may be contributing to impact in specific locations within the Harbor. Additional fish flesh data will be collected and analyzed in order to fully assess the impact of mercury in the Harbor. Long-term monitoring of point and nonpoint sources of mercury will be implemented and Phase II TMDLs will be developed and implemented, as necessary.

Table 6. TMDL: MERCURY (loads in lbs/day total recoverable metal)

Loading Zones	Mun./Ind.	CSOs[1]	Storm Water[2]	Boundary[1]	Atmospheric[3]	TMDLs
Hudson River	0.185	0.057	0.481	0.138	0.245	1.106
Inner Harbor	0.183	0.034	0.007	0	0.054	0.278
Outer Harbor	0.0	0.026	0.010	0	1.139	1.175
Kills	0.328	0.066	0.516	0	0.225	1.135
East & Harlem R.	1.005	0.216	1.260	0	0.679	3.16
Jamaica Bay	0.274	0.106	0.119	0	0.093	0.592
Raritan Bay	0.442	0.005	0.628	0.003	0.328	1.406
Hack/Pas/ Newark B.	0.215	0.060	0.784	0.002	0.036	1.097

Notes: Hack/Pas/Newark = Hackensack River, Passaic River and Newark Bay.
Mun./Ind. = Municipal and Industrial dischargers.
[1] Load includes a projected 10% reduction.
[2] Load includes a projected 30% reduction.
[3] Load includes a projected 60% reduction.

IV. IMPLEMENTATION PLAN FOR TMDLs

The proposed phased TMDLs for copper, mercury, lead and nickel will be implemented as follows:

- Permits will be modified to include limits based on existing effluent quality.

- Monitoring will be required on pollutant sources and ambient receiving water using clean metals techniques. These data will be used to recalibrate the model, as necessary.

- Studies will be required to evaluate effectiveness of corrosion control, pretreatment, plant optimization, and pollution prevention.

- Permits will contain a reopener clause to allow for revised limits and compliance schedules, as necessary, based on new TMDLs/WLAs/LAs.

A monitoring plan has been developed to address the ambient and loading data deficiencies for the NJ tributaries (Appendix 3). The municipal dischargers have agreed, in cooperation with NJDEP and EPA, to fund the cost associated with the additional monitoring and modeling. A schedule for completing Phase II is included in Appendix 4.

In addition, in order to assess the unidentified mercury load and/or verify that it attributed to atmospheric deposition, monitoring will be required to verify loads from:

- municipal and industrial dischargers
- combined sewer overflows and storm water; and
- boundaries.

Under the present TMDL effort no mercury data were available for sediment flux or atmospheric deposition. Under Phase II, Harbor-specific data will be collected to quantify these loads. These efforts will be coordinated with the U.S. Army Corps of Engineers, under the Harbor Estuary Program.

APPENDIX 1: MASTER LIST

NY/NJ HARBOR LIST OF 304(l) AND OTHER DISCHARGERS EVALUATED AS PART OF THE TMDL PROCESS

HUDSON RIVER (BEAR MTN. TO BATTERY) Facility	NPDES #	REASON LISTED	REASON LISTED/ DELISTED	WLAs* (lbs/day total recoverable) Copper	Mercury	Nickel	Lead
Stony Point	NY0028851	MODEL	a				
Peekskill	NY0100803	MODEL	a				
Haverstraw	NY0028533	MODEL	a				
Ossining	NY0108324	MODEL	a				
Orangetown SD2	NY0026051	304(l)	b	NR		NR	NR
Rockland County SD1	NY0031895	304(l)	b	NR		NR	NR
Yonkers	NY0026819	304(l)		NR	0.023018	NR	NR
North River #	NY0026247	304(l)		NR	0.145325	NR	NR
USMA West Point	NY0023761	MODEL	a				
Cragston WTP	NY0022586	MODEL	a				
Havens Road WTP	NY0022596	MODEL	c				
Metro North RR Croton	NY0006866	MODEL	a				
O&R Util Lovett SWM	NY0005711	MODEL		NR	NR	NR	NR
O&R Util Bowline	NY0008010	MODEL	a				
Colgate Palmolive	no record	MODEL	c				
BCF Oil Refining	NY0036609	MODEL	b				
Stony Point Tech Park	NY0006076	MODEL	c				
Edgewater	NJ0020591	304(l)		NR	0.000413	NR	NR
North Bergen	NJ0029084	304(l)		NR	0.000552	NR	NR
West New York	NJ0025321	304(l)		NR	0.001651	NR	NR
Hoboken	NJ0026085	304(l)		NR	0.003417	NR	NR
Octagon Process	NJ0000787	304(l)	b				
Lighthouse Bar & Grill	NJ0029246	NJDEPE	b				

INNER HARBOR (BATTERY to NARROWS)

Owls Head#	NY0026166	304(l)		NR	0.110488	NR	NR
Passaic Valley	NJ0021016	304(l)		NR	0.068805	NR	NR
USM Ocean Terminal	NJ0020257	NJDEPE	b				
IMTT-BX	NJ0002089	304(l)		NR	0.003700	NR	NR

OUTER HARBOR (Narrows to Ocean)

Bay Park	NY0026450	MODEL	a				
Lawrence	NY0020354	MODEL	a				
Long Beach	NY0020567	MODEL	a				
West Long Beach	NY0023523	MODEL	a				
Cedar Creek	NY0026859	MODEL	a				
South West Suffolk	NY0104809	MODEL	a				

KILLS

NYC DOS (Fresh Kills LF)	NY0200867	NYSDEC	b	now deminimus - future to be monitored			
AT&T Nassau Metals	NY0005517	MODEL	b				
Port Richmond #	NY0026107	304(1)		5.8747	0.044786	2.1617	1.2610
Essex Union +	NJ0024741	304(1)		8.8258	0.140237	6.7429	16.2255
Linden-Roselle +	NJ0024953	304(1)		1.8176	0.057095	3.1872	7.0890
Rahway +	NJ0024643	304(1)		13.9578	0.079797	3.4628	6.7387
Sewaren	NJ0020397	MODEL	c				
PSE&G Linden	NJ0000663	304(1)	d				
PSE&G Sewaren	NY0000680	304(1)	d				
Bayway Refining +	NJ0001511	304(1)				3.2693	0.3678
GAF +	NJ0000019	304(1)					0.0847
Hess Pt Reading +	NJ0028878	304(1)					0.0058
A Hess P.A. Terminal	NJ0001376	MODEL	b				
AMAX Realty Devel	NJ0001899	304(1)	b				
AMAX Specialty Coppers	NJ0069353	304(1)	c				
Chevron USA/NE Division	NJ0000221	304(1)		0.730000	0.006100	1.240000	0.100000
CP Chemical	NJ0003867	304(1)	b				
FCM-Carteret	NJ0000248	304(1)	b				
Shell Oil Co-Sewaren	NJ0000752	304(1)	b				
Allied Corp.-Ind. Chem.	NJ0003166	304(1)	b				
American Cyanamid	NJ0001058	304(1)	c				
Cas Chem Inc.	NJ0000949	304(1)	b				
E.I. duPont	NJ0002640	304(1)	c				
LCP Chem. & Plastics	NJ0003778	304(1)	b				
PA, NY & NJ-Newark Airport	NJ0003824	304(1)	b				
Powell Duffryn Terminals	NJ0003361	304(1)	b				
Texaco Refining & Mark.	NJ0002119	304(1)	b				
Royal Petroleum	NJ0003379	MODEL	b				
Schering Corp.	NJ0002305	MODEL	b				
Merck and Company	NJ0002348	MODEL	b				

EAST & HARLEM RIVERS, LONG ISLAND SOUND

Bowery Bay #	NY0026158	304(l)		NR	0.134357	NR	NR
Hunts Point #	NY0026181	304(l)		NR	0.183814	NR	NR
Newtown Creek#	NY0026204	304(l)		NR	0.375400	NR	NR
Red Hook #	NY0027073	304(l)		NR	0.049239	NR	NR
Tallman Island #	NY0026239	304(l)		NR	0.064251	NR	NR
Wards Island #	NY0026131	304(l)		NR	0.197867	NR	NR
Blind Brook	NY0026719	MODEL	a				
New Rochelle	NY0026697	MODEL	a				
Port Chester	NY0026786	MODEL	a				
Mamaroneck	NY0026701	MODEL	a				
Great Neck Village	NY0022128	MODEL	a				
Great Neck SD	NY0026999	MODEL	a				
Glen Cove STP	NY0026620	MODEL	a				
Port Washington	NY0026778	MODEL	a				
Bel Graeve	NY0026841	MODEL	a				
Oyster Bay	NY0021822	MODEL	a				
Konica Imaging	NY0006955	MODEL	a				
Consolidated Edison NY INC.	NY0107522	304(l)	d				
Universal Fixture Corp.	NY0036668	304(l)	b				

JAMAICA BAY

26th Ward #	NY0026212	304(l)		NR	0.073017	NR	NR
Coney Island#	NY0026182	304(l)		NR	0.091990	NR	NR
Jamaica #	NY0026115	304(l)		NR	0.078313	NR	NR
Rockaway #	NY0026221	304(l)		NR	0.030324	NR	NR
Cedarhurst	NY0022462	MODEL	b				
Inwood	NY0026441	304(l)	b				

RARITAN RIVER - BAY

Oakwood Beach #	NY0026174	304(l)		3.1114	0.021530	2.8418	0.4625
Middlesex County +	NJ0020141	304(l)		31.7406	0.420511	17.0902	7.0494
Aberdeen Twnshp. MUA	NJ0022535	304(l)	c				
Aberdeen Twnshp. M	NJ0022543	304(l)	c				
Middletown Twnshp SA	NJ0025356	MODEL	c				
Sayerville GS	NJ0050245	MODEL	b				

HACKENSACK & PASSAIC RIVERS, NEWARK BAY

Bergen County +	NJ0020028	304(1)		7.9376	0.175140	16.6633	28.2538
Meadowview Hosp	NJ0023566	MODEL	b				
North Bergen Cen +	NJ0034339	304(1)		2.5028	0.028698	1.6013	0.6347
Secaucus +	NJ0025038	304(1)		0.7216	0.011585	0.5820	0.2921
Clipper Express	NJ0027251	MODEL	c				
Secaucus Motor Lodge	NJ0028410	MODEL	b				
US Postal Servise	NJ0027758	MODEL	b				
PSE&G Hudson GS	NJ0000647	304(1)	d				
PSE&G Bergen GS	NJ0000621	304(1)	d				
PSE&G Kearny GS	NJ0000655	304(1)	d				
Peridot Chem	NJ0002283	MODEL	d				
Fairmount Chem	NJ0033430	MODEL	d				
Arsynco Inc.	NJ0030970	304(1)	b				
Henkel Process Chem	NJ0002798	304(1)	c				
Matheson Bas Products	NJ0002721	304(1)	c				
SIKA Corp	NJ0002011	304(1)	b				
Technical Oil Products	NJ0005754	304(1)	c				
TR Metro Chem. Co.	NJ0031500	304(1)	b				
Miles Lab	NJ0022608	MODEL	c				
Kalama Chem	NJ0000124	MODEL	b				
BASF Wyandotte	NJ0001112	MODEL	c				
Owens Corning	NJ0035025	MODEL	b				
Columbia Terminals	NJ0025631	MODEL	b				
Benedict Miller	NJ0001031	MODEL	b				
Tramsccontinental Gas	NJ0002101	MODEL	b				
Atlas Plastics	NJ0052736	MODEL	d				
Witco Chem. Co.	NJ0029483	304(1)	d				
Sears Roebuck	NJ0020508	NJDEPE	b				

* = Unless otherwise noted, all loads are are based on Battelle "clean technique" data. For facilities with no available data, the load entered represents the load calculated using the Battelle log mean concentration of all facilities discharging to the Harbor. Log mean concentrations are: Cu: 23.6 ug/L, Hg: 0.0198 ug/L, Ni: 8.83 ug/L,Pb: 1.68 ug/L.

+ = Loads shown for the NJ Dischargers are based on State required non clean technique data collected by the NJ Dischargers during 1992-1993.

= Loads shown for the NY Dischargers are based on NYCDEP clean technique data collected during 1991-1993.

NR = Not required. This means that the waterbody is not water quality-limited and TMDLs/WLAs are not required. The lettered footnotes below describe why individual dischargers do not require WLAs.

a = not within Harbor or model confines.
b = load is deminimus
c = permit terminated
d = noncontact cooling water.

APPENDIX 2

CONCENTRATIONS AND LOADING DATA USED IN MODEL/LOAD MATRICES: BATTELLE, NJ DISCHARGER AND NYCDEP 1991-1993 EFFLUENT DATA

Facility	Flow (MGD)	Concentrations (ug/L T.R.)* Cu	Hg	Ni	Pb	Loadings (lbs/day) [total recoverable] Cu	Hg	Ni	Pb
HUDSON RIVER (BEAR MTN. TO BATTERY)									
Peekskill	10.00	23.40	0.0198	49.60	51.70	1.95	0.0017	4.14	4.31
Haverstraw	8.00	23.60	0.0198	8.83	1.68	1.57	0.0013	0.59	0.11
Ossining	7.00	66.70	0.0198	8.83	1.68	3.89	0.0012	0.52	0.10
Orangetown SD2	12.75	45.60	0.0198	8.83	1.68	4.85	0.0021	0.94	0.18
Rockland County SD	26.00	56.60	0.0198	8.83	1.68	12.27	0.0043	1.91	0.36
Yonkers	92.00	26.15	0.0300	21.85	4.04	20.06	0.0230	16.77	3.10
North River #	170.00	32.03	0.1025	5.65	3.71	45.41	0.1453	8.01	5.26
Edgewater	2.50	23.60	0.0198	8.83	1.68	0.49	0.0004	0.18	0.04
North Bergen	3.34	23.60	0.0198	8.83	1.68	0.66	0.0006	0.25	0.05
West New York	10.00	23.60	0.0198	8.83	1.68	1.97	0.0017	0.74	0.14
Hoboken	20.80	15.10	0.0198	23.90	1.29	2.62	0.0034	4.15	0.22
O&R Util Lovett SW	0.25	23.60		8.83	1.68	0.05		0.02	0.00
Mean =		31.97	0.03	14.30	6.18				
INNER HARBOR (BATTERY to NARROWS)									
Owls Head #	120.00	46.56	0.1104	12.80	11.69	46.60	0.1105	12.81	11.70
Passaic Valley	330.00	26.00	0.0250	50.55	20.30	71.56	0.0688	139.12	55.87
IMTT-BX	2.06	25.70	0.2181	41.10	3.90	0.44	0.0037	0.71	0.07
Mean =		32.75	0.12	34.82	11.96				
OUTER HARBOR (Narrows to Ocean)									
NO DIRECT MUNICIPAL OR INDUSTRIAL DISCHARGERS						NO DIRECT DISCHARGERS			
Mean =		0.00	0.00	0.00	0.00				
KILLS									
Port Richmond +	60.00	11.74	0.0895	4.32	2.52	5.87	0.0448	2.16	1.26
Essex Union +	75.00	14.11	0.2242	10.78	25.94	8.83	0.1402	6.74	16.23
Linden-Roselle +	17.00	12.82	0.4027	22.48	50.00	1.82	0.0571	3.19	7.09
Rahway +	40.00	41.84	0.2392	10.38	20.20	13.96	0.0798	3.46	6.74
Chevron USA/NE Div	3.67	24.00	0.2000	40.60	3.40	0.73	0.0061	1.24	0.10
Bayway Refining +	9.80			40.00	4.50			3.27	0.37
GAF +	3.07				3.31				0.08
Hess Pt Reading +	0.08				8.71				0.01
Mean =		20.9020	0.2311	21.43	14.82				
EAST & HARLEM RIVERS, LONG ISLAND SOUND									
Bowery Bay #	150.00	19.14	0.1074	10.32	3.71	23.94	0.1344	12.91	4.64
Hunts Point #	200.00	12.23	0.1102	6.30	2.24	20.40	0.1838	10.51	3.74
Newtown Creek #	310.00	75.19	0.1452	15.38	6.08	194.40	0.3754	39.76	15.72
Red Hook #	60.00	11.60	0.0984	3.54	2.40	5.80	0.0492	1.77	1.20
Tallman Island #	80.00	14.29	0.0963	5.15	0.92	9.53	0.0643	3.44	0.61
Wards Island #	250.00	15.78	0.0949	2.76	1.95	32.90	0.1979	5.75	4.07
Mean =		24.71	0.1087	7.24	2.88				
JAMAICA BAY									
26th Ward #	85.00	11.34	0.1030	5.02	2.67	8.04	0.0730	3.56	1.89
Coney Island #	100.00	31.76	0.1103	3.58	4.82	26.49	0.0920	2.99	4.02
Jamaica #	100.00	20.69	0.0939	3.08	3.04	17.26	0.0783	2.57	2.54
Rockaway #	45.00	8.13	0.0808	1.48	1.57	3.05	0.0303	0.56	0.59
Mean =		17.98	0.0970	3.29	3.03				
RARITAN RIVER - BAY									
Oakwood Beach #	39.90	9.35	0.0647	8.54	1.39	3.11	0.0215	2.84	0.46
Middlesex County +	147.00	25.89	0.3430	13.94	5.75	31.74	0.4205	17.09	7.05
Mean =		17.62	0.2039	11.24	3.57				

HACKENSACK & PASSAIC RIVERS, NEWARK BAY

Bergen County +	75.00	12.69	0.2800	26.64	45.17	•	7.94	0.1751	16.66	28.25
North Bergen Cen +	10.00	30.01	0.3441	19.20	7.61	•	2.50	0.0287	1.60	0.63
Secaucus +	5.12	16.90	0.2713	13.63	6.84	•	0.72	0.0116	0.58	0.29
Mean =		19.87	0.2985	19.82	19.87	•				

* = Unless otherwise noted, all concentrations are Battelle "clean technique" data. For facilities with no available data, the data entered represents the Battelle log mean concentration of all facilities discharging to the Harbor. Log mean concentrations are: Cu: 23.6 ug/L, Hg: 0.0198 ug/L, Ni: 8.83 ug/L,Pb: 1.68 ug/L.

+ = Concentrations shown for the NJ Dischargers are based on State required non clean technique data collected by the NJ Dischargers during 1992-1993.

= Concentrations shown for the NY Dischargers are based on NYCDEP clean technique data collected during 1991-1993.

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APPENDIX 3: PROPOSED MONITORING AND MODELING PLAN FOR NJ TRIBUTARIES [1]

Ambient, Effluent and Atmospheric Monitoring Requirements

All metals monitoring should be executed utilizing "clean techniques" for both sampling and analyses. For effluent monitoring, these methods do not require any changes in analytical techniques which are not in compliance with applicable EPA effluent analytical techniques.. This is demonstrated by the techniques used by New York City in previous monitoring efforts in the Harbor.

I. Data Base Enhancement - Master Station and Wet Weather Survey: The first step is to conduct a "master station and wet weather survey" in order to enhance the existing information on the relevant metals in the NJ tributaries. The intent of this is to accurately determine whether these metals are present at levels of concern, and if so, in which tributaries and to what extent).

- Parameters: Dissolved and total recoverable copper, lead, nickel, and mercury; TSS, DOC, PC, and salinity

- Stations and locations: Four stations (1 each in the Hackensack, Passaic, and Raritan Rivers, and 1 in Newark Bay)

- Sampling Frequency: Sample at least 3 times per week for one month, which must include wet weather

- Develop probability distributions

- Define which metals are problematic and/or which tributaries show criteria exceedances (based on the results of this survey, certain metals and/or tributaries may be eliminated).

II. Ambient Monitoring Requirements:

1. One Dry Weather Survey:

- Parameters: Dissolved and total recoverable copper, lead, nickel, and mercury; TSS, DOC, PC, and salinity

- Stations and locations: Sixteen stations (1 upstream boundary station in each of the Hackensack, Passaic, and Raritan Rivers, 3 stations in each of the Hackensack and Passaic Rivers, 2 stations in the Raritan River, 1 station in Newark Bay, 1 in Raritan Bay, 2 in the Kills and 1 in Upper New York Bay)

- Sampling Frequency: Two to four samples over a tidal cycle.

[1] Proposed monitoring plan to be revised, as necessary, based on current monitoring needs.

2. Two Wet Weather Surveys:

- Parameters: Dissolved and total recoverable copper, lead, nickel, and mercury; TSS, DOC, PC, and salinity
- Stations and locations: Same as the ambient dry weather survey
- Sampling Frequency: Three days of surveying (rain day plus the 2 following days). 2 to 4 passes per day.

III. Municipal Plant Monitoring Requirements:

Effluent:

- Parameters: Dissolved and total recoverable copper, lead, nickel, and mercury; TSS, DOC, and PC
- Stations and locations: Sample only those municipal treatment plants discharging to the tributaries and the Kills
- Sampling Frequency: Monthly for six months.

Influent:

- Parameters: same as effluent
- Sampling Scheme: To estimate metals input from CSOs, influent from 2 facilities on each tributary (the Hackensack, Passaic, Raritan Rivers and Newark Bay are considered separate tributaries for the purposes of these monitoring requirements) should be monitored and compared during dry vs. wet weather events.
- Sampling Frequency: Four wet weather events and four dry weather events for each facility

IV. CSO Monitoring Requirements:

- Parameters: Same as effluent monitoring
- Sampling Scheme: To estimate metals input from CSOs, 10 sites over the area should be monitored during storm events that are sufficient to cause the regulator to divert flow from the treatment plant. Collect samples every 15 minutes for 2 hours (composite sample)
- Sampling Frequency: Four events per site.

V. Storm Water Monitoring Requirements:

- Parameters: Same as effluent monitoring

- Sampling Scheme: To estimate metals input from storm water, 10 appropriate storm water outfalls over the study area should be sampled. Collect samples every 15 minutes for 2 hours (composite sample)

- Sampling Frequency: Four Events per site.

VI. - Atmospheric Deposition

Wet and dry atmospheric deposition data will be collected at stations throughout the Harbor. Monitoring will be coordinated with air programs in federal and state agencies. A more detailed atmospheric data collection plan will be developed in coordination with existing programs.

Modeling Framework

I. Develop probability distributions for Passaic, Hackensack and Raritan Rivers and Newark Bay to determine if criteria are exceeded and therefore, the waterbody is water quality-limited.

II. Prepare estimates of loading categories: boundary, municipal and industrial point sources, runoff from combined sewers and storm water using the RRMP model.

III. Calibrate and verify NY-NJ Harbor model for water quality-limited waters and corresponding metals.

IV. Determine relative contributions of metals from loading categories.

V. Revise loading matrices to reflect updated calibration for NJ tributaries.

VI. Verify allocation schemes developed by Harbor TMDL work group.

APPENDIX 4: PROPOSED SCHEDULE FOR PHASE II TMDL DEVELOPMENT (preliminary dates should be used to establish timeframes, only)

Feb '95	Conduct master station and wet-weather survey
Feb'95	Begin municipal plant monitoring (six months)
Apr.'95	CSO and SW surveys completed (four CSO and SW surveys should be completed by this date)
Apr.-Mar.'95	Conduct two wet-weather surveys
Aug.'95	Conduct dry-weather survey
Oct.'95	Data collection and analysis completed
Dec.'95	Modeling Analysis completed
Mar.'96	TMDLs/WLAs/LAs revised, as necessary
Apr.'96	Public Notice TMDLs
June '96	Begin permit modification process

APPENDIX 5: REFERENCES

Battelle Ocean Sciences. 1991. Evaluation of Trace Metal Levels in Ambient Waters and Discharges to New York-New Jersey Harbor for Waste Load Allocation (January 1991 Survey). New York City Department of Environmental Protection, NY. Report dated September 30, 1991.

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